REMARKS

Claim Rejections - 35 U.S.C. § 102/103

The Examiner has rejected claims 1, 2, 4, 6-8, 11-14, and 24 under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Avanzino et al. (US Patent 6,140,239). The Examiner has rejected claim 5 under 35 U.S.C. § 103(a) as being unpatentable over Avanzino et al. (US Patent 6,140,239). The Examiner has rejected claims 3, 9, 10, 25 and 26 under 35 U.S.C. § 103(a) as being unpatentable over Avanzino et al (US Patent 6,140,239) as applied to claims 1, 2, 4-8, 11-14, and 24 above

It is the Examiner's position that Avanzino teaches that a dielectric layer may be formed over a substrate and that the dielectric layer may have trenches therein. A barrier may be formed in the trenches and on the top surface of the dielectric layer. A metal may be deposited over the barrier. The metal, such as copper may be polished with a slurry which includes an abrasive. The dielectric layer may comprise an oxide of silicon. The barrier is electrically conductive, such as tantalum or tantalum nitride. Although, Avanzino does not specify that the slurry includes an abrasive harder than the metal and less harder than the barrier, it is the Examiner's position that such a limitation is inherent in Avanzino. It is the Examiner's position that because the same materials are used with the same process steps, Avanzino would inherently contain the same properties and functions as claimed (i.e., the abrasive harder than the metal (such as copper) and less harder than the barrier (such as tantalum or tantalum nitride)).

It is Applicant's understanding that the cited references fail to teach or render obvious Applicant's invention as claimed in amended independent claims 1, 11 and 24. In amended claims 1, 11 and 24, Applicant claims a method of polishing a first film overlying second film wherein the second film is harder

than the first film. According to Applicant's claimed method, the first film is polished with a slurry comprising an abrasive having a hardness greater than the hardness of the first film and less than the hardness of the second film and wherein the abrasive comprises one or more materials selected from the group consisting of strontium titanate, apatite, dioptase, iron, brass, fluorite, oxide, and azurite. The abrasive hardness strategy of the present invention provides a method for controlling the selectivity of a polishing process utilizing the mechanical attributes rather than the chemical attributes of the slurry. The present invention provides a method of achieving desired high polish selectivity between to films by utilizing an abrasive which is harder than the metal to be polished but yet less hard than the barrier metal upon which the metal layer is formed.

Avanzino simply teaches a slurry containing iron oxide for polishing a copper film. Avanzino makes no teaching or suggestion, whatsoever, of the importance of utilizing an abrasive which is harder than the metal to be polished but yet softer than the material upon which the metal is formed in order to control the selectivity of the slurry. Avanzino fails to teach utilizing an abrasive selected from the group consisting of strontium titanate, apatite, dioptase, iron, brass, fluorite, oxide, and azurite. Additionally, it would not be obvious to utilize Applicants specified abrasives, because Avanzino makes not teaching or suggestion of alternatives to iron oxide nor does Avanzino teach or suggest the necessary physical or mechanical attributes of the abrasive (e.g., hardness) which would suggest the use of Applicant's claimed abrasives. As such, for the above mentioned reasons, it is Applicant's understanding that the cited references fail to teach or render obvious Applicant's invention as claimed in claim 1-8, 10-12, 14, 24 and 25. As such, Applicant respectfully requests the removal of the 35 U.S.C. § 102 and 103 rejections of these claims and seeks an early allowance of these claims.

With respect to new claim 31, Applicant claims a method of forming an interconnect wherein a barrier layer is formed over and into trenches formed in a

hard dielectric layer. A metal layer is then deposited over the barrier layer. The metal layer is then polished with a slurry that includes an abrasive which is harder than the metal and less hard than the barrier layer. After removing the metal layer by polishing and exposing the barrier layer on the top surface of the dielectric, the barrier layer on the top surface of the dielectric is polished utilizing the same slurry used to polish the metal layer. By utilizing a slurry having an abrasive that is harder than the metal layer but less hard than the barrier layer and wherein the dielectric layer is formed of a material having a hardness similar to the barrier layer, then the same slurry can be utilized to remove the barrier layer from the dielectric as is used to remove the metal layer from the barrier layer.

It is Applicant's understanding that Avanzino teaches to utilize two different CMP processes. The first CMP process is utilized to remove copper layer 20 from barrier layer 14 (Col. 5, lines 34-47). The first CMP process stops on barrier 14 as shown in Figure 3. After the first CMP process the substrate is cleaned of residual iron particles with a dilute organic acid (Col. 5, lines 39-43). After stopping on barrier layer 14 and cleaning the substrate of residual iron oxide, a second CMP process is used to remove barrier layer 14 from the upper surface of the interlayer dielectric layer 10 leaving a planarized surface as shown in Figure 4 (Col. 5, lines 44-47). As such, Avanzino clearly fails to teach removing the barrier layer 14 with the same slurry as utilized to remove copper layer 20. Additionally, it is to be appreciated that one of ordinary skill in the art would not be motivate to utilize the slurry used to polish copper layer 20 to polish barrier layer 14 because Avanzino specifically teaches to clean the substrate to remove residual iron oxide (i.e., remove remaining portion of the first slurry) prior to polishing the barrier layer. As such, for the above mentioned reasons, it is Applicant's understanding that Avanzino fails to teach or render obvious Applicant's invention as claimed in new claim 31.

PETITION FOR EXTENSION OF TIME
PURSUANT TO 37 C.F.R. § 1.136 (a)

Applicant respectfully petitions pursuant to 37 CFR 1.136(a) for a one-month extension of time to file this response to the Office Action mailed August 6, 2001. The extended period is set to expire on December 6, 2001. A check in the amount of $110.00 is enclosed to cover the fee for a one-month extension of time.

If there are any additional charges, please charge Deposit Account No. 02-2666.

Respectfully submitted,
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: 12/6/01

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

1. (Amended) A method of forming interconnect, comprising:

forming a dielectric layer over a substrate, the dielectric layer having trenches therein;

forming a barrier in the trenches and on a top surface of the dielectric layer;

depositing metal over the barrier; and

polishing the metal with a slurry that includes an abrasive harder than the metal and less hard than the barrier and wherein said abrasive comprises one or more materials selected from the group consisting of strontium titanate, apatite, dioptase, iron, brass, fluorite, and azurite.

11. (Amended) A method of polishing a first film overlying a second film wherein the second film is harder than the first film, comprising:

polishing the first film with a slurry comprising an abrasive having a hardness greater than a hardness of the first film and less than the hardness of the second film and wherein said abrasive comprises one or more materials selected from the group consisting of strontium titanate, apatite, dioptase, iron, brass, fluorite, and azurite.

24. (Amended) A method of forming a damascene structure, comprising:

forming trenches in an insulating layer disposed on a substrate, the trenches having a bottom surface and side surfaces;

forming a barrier layer over a top surface of the insulating layer and over the bottom and side surfaces, the barrier layer having a first hardness;

forming a layer of metal over the barrier layer; and

removing the metal layer from over the that portion of the barrier layer that overlies the top surface of the insulating layer;

wherein removing the metal layer comprises polishing the metal with a slurry having an abrasive that is harder than the metal and less hard than the barrier layer and wherein said abrasive comprises one or more materials selected from the group consisting of strontium titanate, apatite, dioptase, iron, brass, fluorite, and azurite.